P801314wod,

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 677 652 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **95103779.5**

(22) Date of filing: **15.03.95**

(51) Int. Cl.[6]: **F02F 1/10**, F16J 10/04, F02B 77/02

(30) Priority: **18.03.94 JP 74317/94**

(43) Date of publication of application:
18.10.95 Bulletin 95/42

(84) Designated Contracting States:
DE FR GB IT

(71) Applicant: **YAMAHA HATSUDOKI KABUSHIKI KAISHA**
2500 Shingai
Iwata-shi
Shizuoka-ken, 438 (JP)

(72) Inventor: **Koriyama, Masao**
c/o 2500 Shingai
Iwata-shi,
Shizuoka-ken, 438 (JP)

(74) Representative: **Grünecker, Kinkeldey,**
Stockmair & Schwanhäusser
Anwaltssozietät
Maximilianstrasse 58
D-80538 München (DE)

(54) Linerless engine cylinder block.

(57) The present invention relates to a linerless engine cylinder block made of a aluminium alloy comprising at least one cylinder (2), which slideably receives a piston (5) sliding along an inside surface (4) of the cylinder (2), said piston (5) being connected to a crankshaft by a connecting rod (7). The inside surface (4) of the cylinder (2) comprises two portions, namely a plated main portion (4) and a lower portion (4B) which is left unplated. Preferably said lower portion (4B) provides a seat (16) for a plating tool during the plating process.

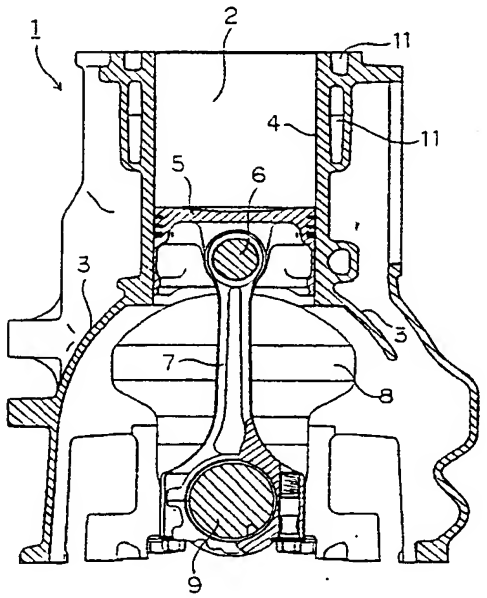

FIG. 1

EP 0 677 652 A1

An embodiment of the linerless cylinder block of this invention will be described below with reference to the figures.

Figure 1 shows a piston positioned at its lower dead point in a linerless cylinder block of this invention. The cylinder skirt area 3 of the cylinder block is formed as a unit which is contiguous with the lower end of the cylinder 2 in the cylinder block 1. Piston 5 slides against the inside surface 4 in the cylinder 2. The piston 5 is linked to a connecting rod 7 by means of a piston pin 6; said rod 7 in turn moves around the surface of a crank pin 9 formed integrally with a balance weight 8 and a crank arm (not shown) in a manner such that the up-down oscillation of the piston causes the crankshaft to rotate.

Figures 2 and 3 shows the entire cylinder block, in this case an aluminum alloy integral unit. Four cylinders 2 are aligned in a row in the cylinder block 1. As shown in Figure 2, there is a continuous water jacket 11 with openings in the top surface of the cylinder block 1 around the cylinders 2. Additional openings are shown for left and right bolt holes 12 between the first and second and the third and fourth cylinders, oil drop holes 13 that link the valve chamber formed by the cylinder head and head cover with the crank case, and ventilation holes 14.

A water pump 21 and thermostat 22 control the flow of coolant water for the water jacket 11 in the cylinder block 1, and Figure 4 shows their position relative to the cylinder block 1.

Also, as shown in Figure 3, upper bearing areas 15 for the crank shaft are located below the partition walls between the cylinders 2 in the cylinder block 1 and are thicker than the partition walls between the cylinders; these bearing areas 15 are integrally formed into a bridge-like shape in the cylinder block 1.

Figures 5 and 6 show that the inside surface 4 for each cylinder 2 in the foregoing cylinder block 1 extends below the lower dead point of the piston shown at position C. Figure 7 shows that a nickel or chrome plating 4a or a Ni-P-Si coat has seen applied to the inner surface of the cylinder above position C, but no plating has been applied to the part of inside cylinder surface 4b that extends below position C.

By extending the inside surface of the cylinder 4 below the bottom edge of the piston at position C, it becomes possible, as shown in Figure 7, to form a thick-walled area 23 where the bottom of the cylinder 2 joins the cylinder skirt area 3.

Further, as shown in Figure 6, a step 16 is formed inside the cylinder block 1 at the bottom of the cylinders 2 and just above the crankshaft upper bearings; it projects circularly from the inside surface of each cylinder 4 toward the cylindrical axis.

Figure 8 shows the plating operation of the cylinder inside in an aluminum alloy cylinder block 1 of the above described construction. A sealing jig 30 that was inserted into the cylinder 2 from the opening in the top of the cylinder block is automatically positioned by indexing on the step 16 formed above the upper crankshaft bearing areas. The sealing jig 30 completely seals off the bottom opening of the cylinder 2, and allows the upper part of the inside of wall 4 of the cylinder that lies above the seal to be plated by the plating solution that flows into the top opening of the cylinder 2.

The sealing area of the inside cylinder wall 4 in contact with the sealing jig 30 corresponds to the area 4b that lies below position C: the bottom edge of the piston at its lower dead point. Accordingly, the 4b area is not plated. Since the area 4b is outside the area where the piston slides, there is no requirement to increase its abrasion resistance by plating.

As described above, the cylinder block in this embodiment does not require that the sealing jig 30 be inserted from the bottom of the cylinder block 1 into cylinder 2 during the plating process, thereby eliminating any need for cutting away material between the cylinder walls and reducing the thickness at the upper crankshaft bearing areas 15 in order to accommodate the sealing jig. Further, the step areas 16 at the bottom of the cylinders 2 allow the automatic positioning of the seal at the position corresponding to the bottom edge of the piston inside of cylinders 2.

Also, the creation of the extended surface 4b of the inside surface 4 of the cylinder, in addition to allowing space for the sealing surface on the inside of the cylinders and allowing easy positioning of the sealing jig, further allows creating a thick wall area 23 where the bottom of the cylinders 2 joins the skirt area 3, a structure that improves the strength of this area and lowers noise during engine operation.

In linerless cylinder blocks having tightly adjoining cylinders with but thin walls between them, there is little room for heat to escape from the wall areas between the cylinders. However, the heat dissipation from the wall areas between the cylinders, and the cooling properties have been improved in this embodiment by forming the oil drop holes 12 and the ventilation holes 13 just outside the walls between the cylinders. Further, the overall strength of the cylinder block is improved because these oil drop holes 12 and ventilation holes 13 create passages in the vertical direction, thereby further abating the potential for noise.

Also, the linerless cylinder block of this invention provides for good heat dissipation from the cylinders, which allows, as shown in Figure 1, the water jacket 11 to be smaller, and the contact

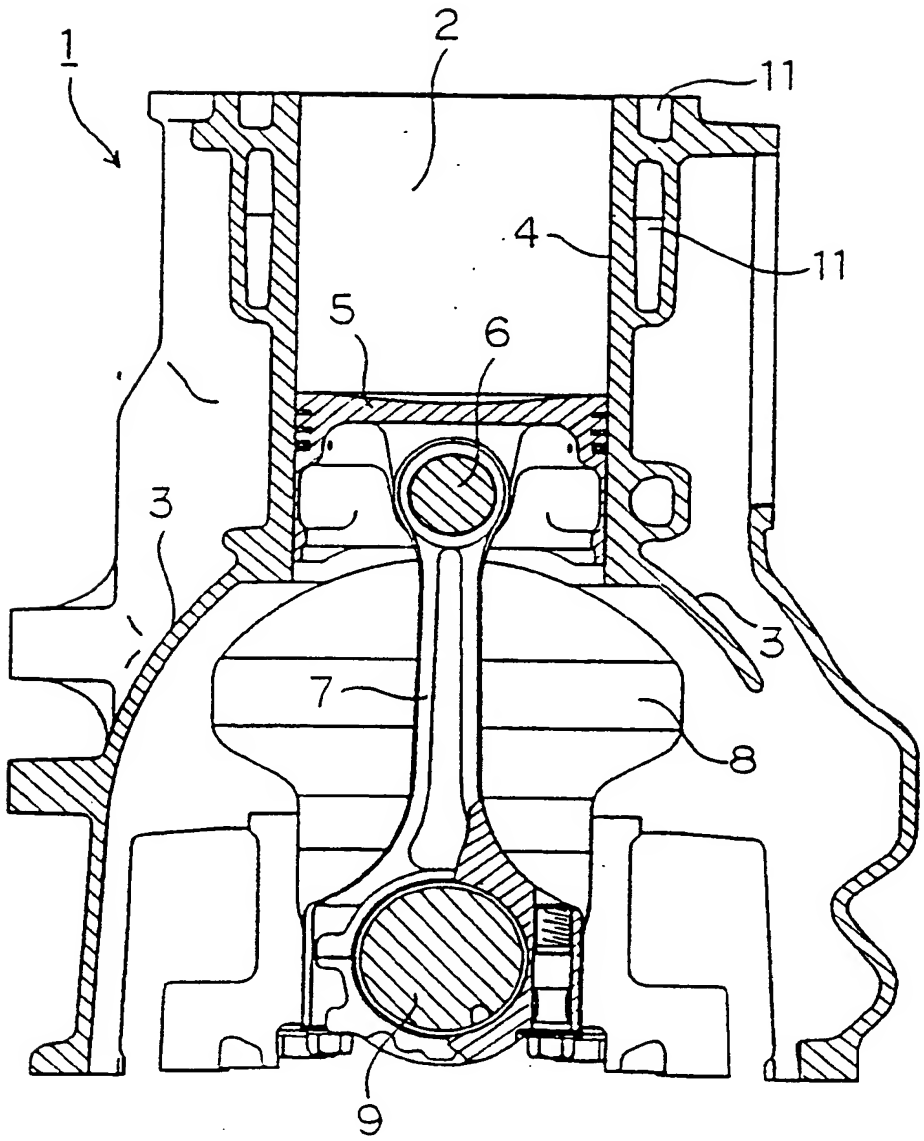

FIG. 1

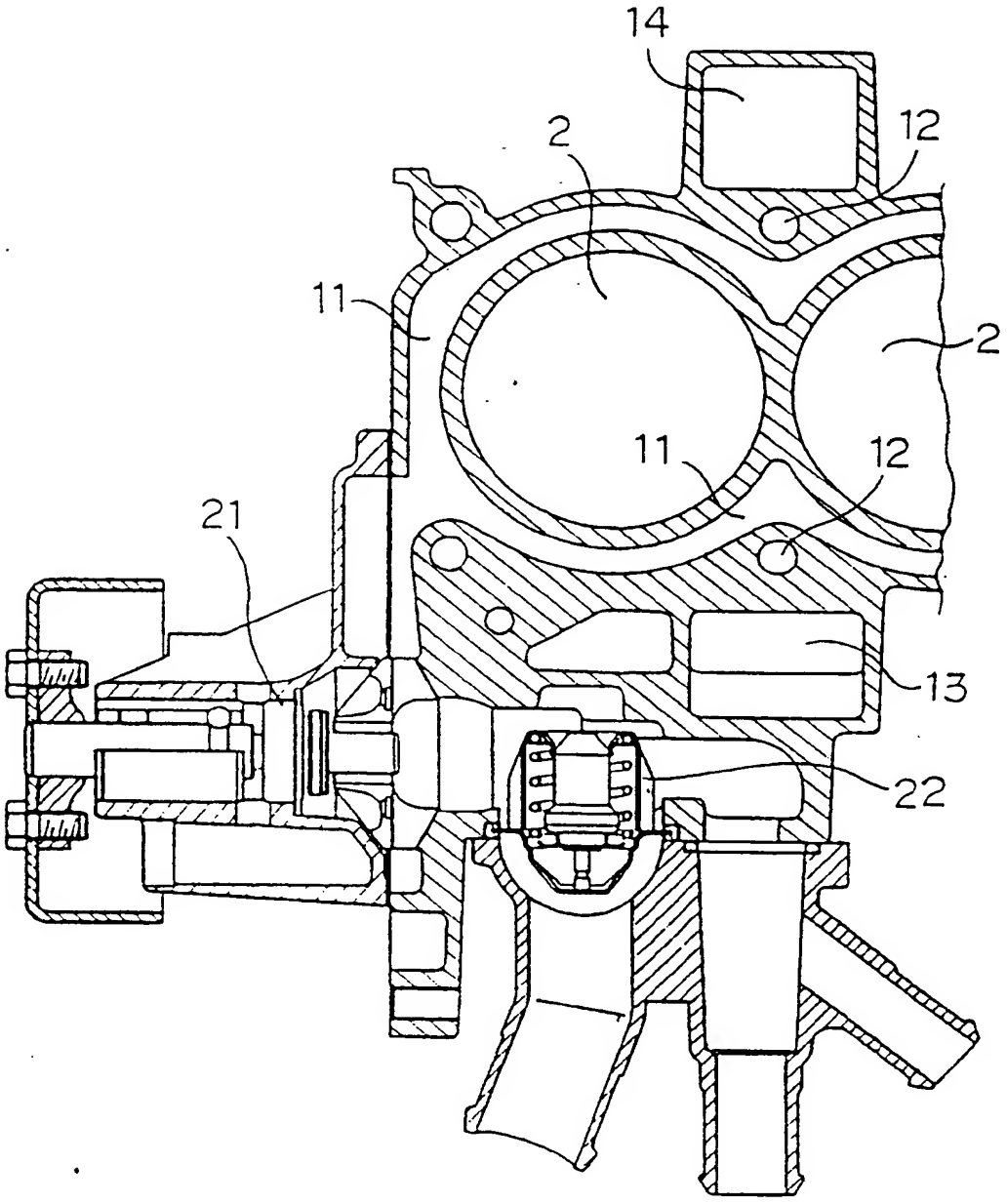

FIG. 4

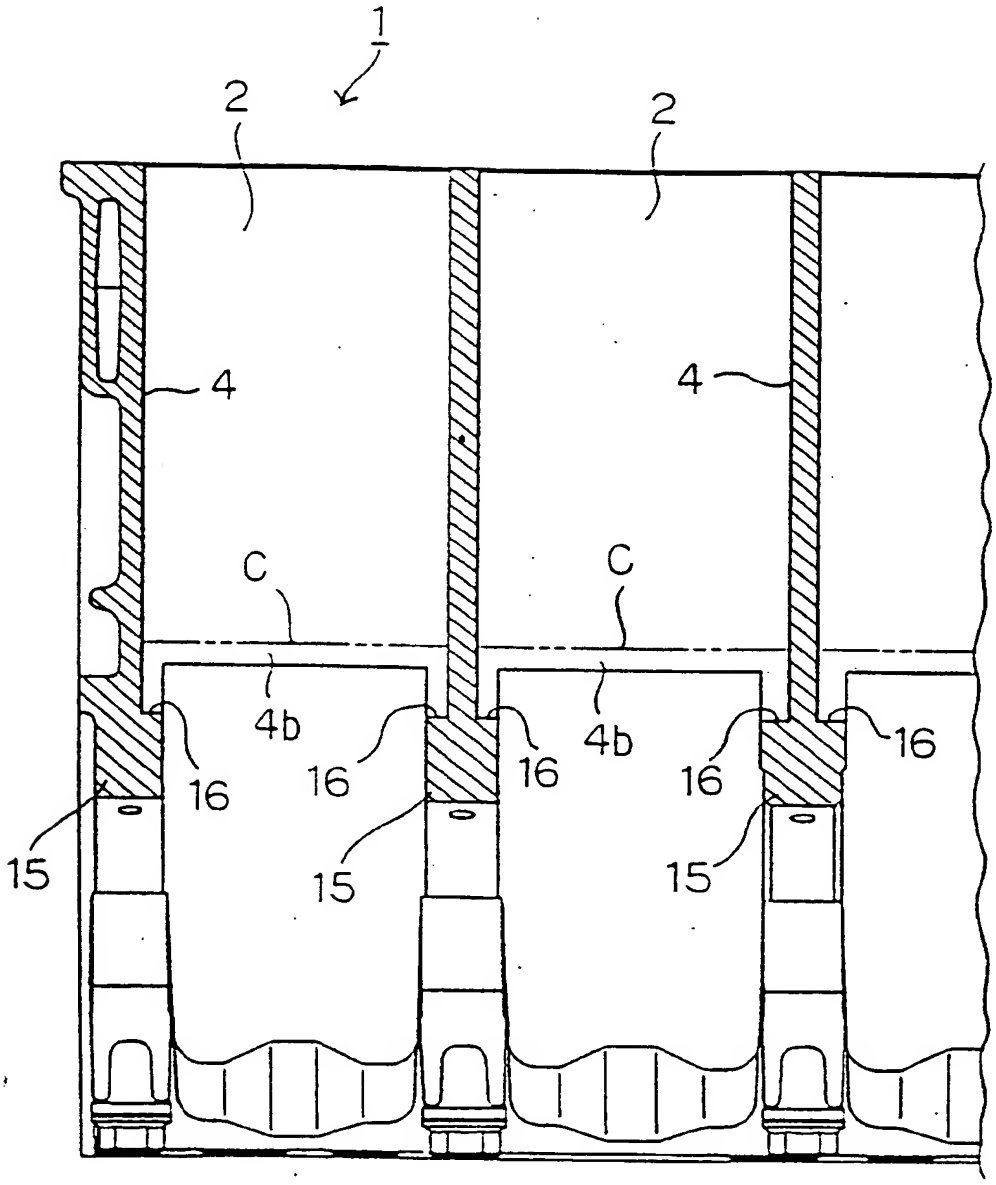

FIG. 6

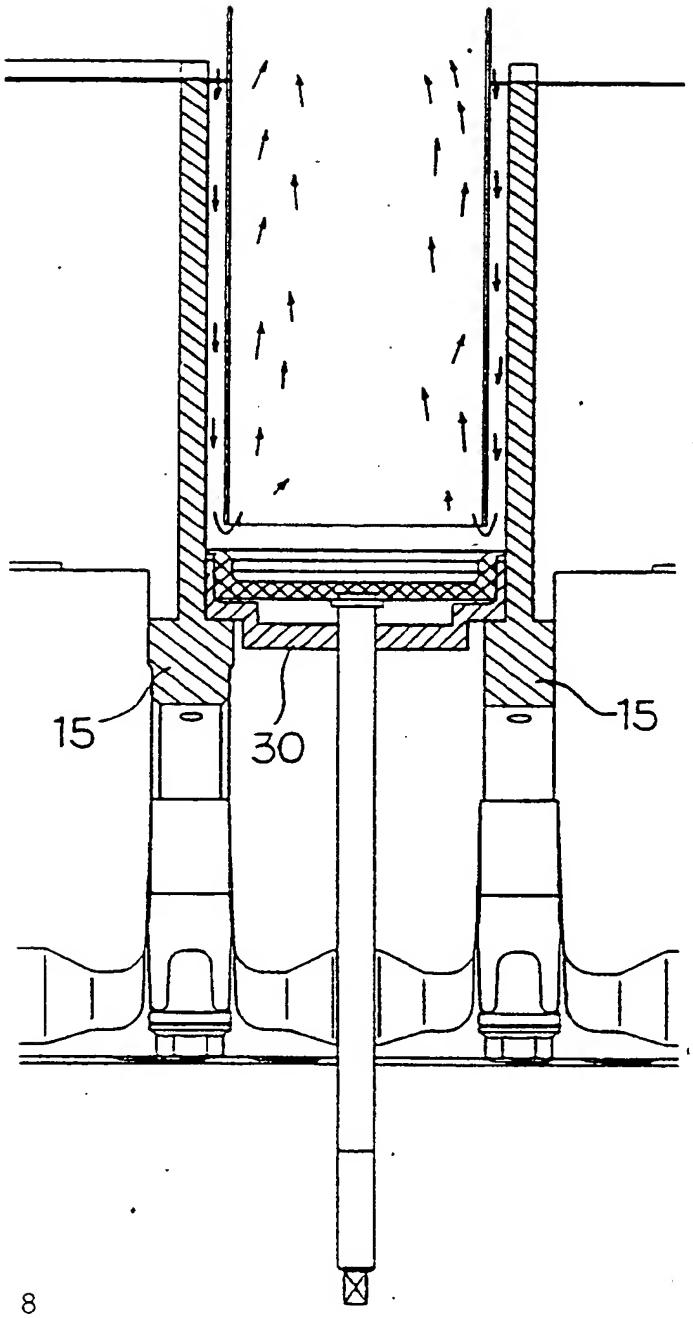

FIG. 8